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## ENTOMOLOGICAL RESEARCH AND UTILITY

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**T**HERE has been no period when there was more demand for practical means for the control of insects—methods which could be applied in the garden, the field and even forests and yield results commensurate with the costs. The reason is found in the high prices of all crops and the urgent need of greater production. The latter may be secured by increased planting or better protection and usually by a combination of the two, since a greater acreage is easily offset by insect depredations or other untoward developments. It is only necessary to recall that estimates made several years ago of the total annual losses caused by insects in the United States overran the billion-dollar mark and to-day probably approach twice that sum. This gives an idea of what insect activities mean in a practical way. A large proportion of this waste is preventable and if it were eliminated would go far to relieve the burden of taxation.

All manner of crops, animals and products are levied upon by insects. Wheat may be blasted by the Hessian fly, green aphid and wheat midge; potatoes seriously damaged by potato beetles, wire worms and white grubs; corn destroyed by white grubs, corn root worms or army worms; cotton has its enemies in the cotton boll weevil and the cotton worm; stored food products may become infested by meal worms, contaminated by roaches and spoiled by weevils; fabrics are ruined by clothes moths; lumber and even dwellings are rendered worthless by various borers, while our domestic animals are worried by horn flies and driven to desperation by black flies and gadflies. Man is by no means exempt from attack by malevolent forms such as body lice, especially in the trenches; the house fly with its disease-carrying potentiality is a menace in both home and camp, and the same is true of a number of mosquitoes. This has all become increasingly important under present conditions, especially in the field and camp, where opportunities for protection are greatly reduced and the chances for infestation increased on account of the frequent changes and enforced associations.

In other words, the menace of the insect has become immensely greater and with changing conditions incident to war, especially in those unfortunate sections blighted by military activities, there will be new adaptations on the part of the more

destructive insects. The lower type of agriculture due to the lack of labor and the absence of sufficient fertilizers is apt to be followed by insect injury of a type now largely restricted to less progressive regions. The grasshopper, that plague of ancients and devastator of the western plains, especially in earlier days, may find among the scanty crops of poorly cultivated fields conditions favorable to extended depredations. This period of readjustment is the time when most careful attention should be given to insect life and the causes favoring its development. There is a special need for searching out ways of preventing loss by modifications in practice, since many of the remedial operations such as spraying may be made impossible owing to a lack of labor and an absence of means. There is no extra expense, for example, in delaying the sowing of wheat until danger of attack by the Hessian fly has passed. It costs practically nothing to modify crop rotations so that corn and potatoes will not be planted on sod land badly infested by white grubs or wire worms, thus inviting disaster. Such matters are of great importance in times of stress. We should know that the successful prevention of injury in any such manner must depend upon an exact knowledge of habits and limitations, something which can be acquired only by years of experience or through painstaking investigations.

Introduced and new insect pests also present serious and in some cases acute problems which may demand immediate solution if extended depredations are to be avoided. It is well known, for example, that over half of our most injurious insects have been introduced from abroad, and during recent years there have been formidable additions to the number, such as the gypsy moth, the brown tail moth, the pear thrips and the cotton-boll weevil, to mention only a few. This process is continuing and no one can foresee its limits. The past season has witnessed the discovery in New York state of an apple and thorn skeletonizer, a European insect capable of defoliating entire orchards and one which appears to have become recently established in this country. Native species are responding to changed environment and causing losses which can not be prevented without the direction possible through exact knowledge of the life history and habits of the pest. Both the introduced species and native insects which become seriously injurious give little warning of their destructive abilities and frequently arise from the ranks of the previously unknown or almost ignored. This class of pests alone justifies long continued studies in unraveling the numerous biological problems presented by insect life, since no one could foretell what facts, though apparently insignificant of themselves, may determine

the possibility of practical control for widespread and destructive pests.

The assembling on fields of battle of representatives from all parts of the world, and the inevitable later scattering of units means the establishment in many localities of individuals infected with most of the diseases to which man is heir, and with a presumptive relaxation of the present rigid military control upon the establishment of peace, there will be an unexampled opportunity for various insects to serve as carriers of deadly infections so frequently associated with war, such as typhus, bubonic plague, cholera, typhoid fever, dysentery and smallpox, most of which may be carried by insects even if they are not largely disseminated in this manner. Only the most thorough precautions can prevent extensive outbreaks of these diseases, and certain safeguards are possible only when there is an intimate knowledge of the habits of the insects serving as carriers. The warstricken areas lack the ordinary sanitary provisions, and the numerous cases of noxious diseases occurring therein can not but serve as centers for the dissemination of infection among an unusually susceptible population due to the lowered vitality incident to exposure and deficient nutrition. This is the situation obtaining in some sections of the world and very likely to spread over considerable areas unless the danger is fully appreciated and every possible precaution adopted.

Practical insect control depends absolutely, whether it be recognized or not, upon exact knowledge of the life history and habits of insects. Outbreaks by various pests are simply responses to environments and it is the duty of the scientist to read carefully the pages of history and determine so far as practical what portions are to be repeated in the near future. Changes in agricultural methods are inevitable with the scarcity of help, and we must see to it that such modifications do not produce unduly favorable conditions for insect outbreaks. We must anticipate unexpected mischief so far as practical, and this for the entomologist is no small undertaking when the enormous number of species he is called upon to deal with is taken into account. This is no time to restrict research. There should rather be a great extension of activities if the entomologist is to render the best service to his country and to mankind. He should seek as never before for the limiting factors which render an insect innocuous and if possible prevent it becoming unduly abundant and destructive. This should be a campaign of knowledge directed largely toward preventive measures, since combative and remedial measures may frequently be impossible.